ABSTRACT

A sintering schedule to allow the reliable formation of inorganic or ceramic materials, exemplified using porous calcium polyphosphate samples to be used for forming novel implants for bone interfacing applications. The key to the successful definition of the process was the determination of the factors affecting the crystallization temperature of the powders that are gravity sintered to form porous samples of desired density and with a pore size range suitable for the particular application. The method involves applying a sintering procedure to a packed amorphous inorganic powder which gives control over densification and includes choosing sintering temperatures and times sequentially that correspond to the inorganic material being amorphous but having a viscosity to develop significant sinter necks between adjacent powder particles by a viscous flow sintering mechanism while maintaining a desired open-pored structure, followed by a second temperature at which crystallization of the packed amorphous inorganic powder occurs and during which slower diffusion-related mechanisms control sinter neck growth and densification to give a substantially crystalline porous, inorganic structure. In addition, interpenetrating phase composites of biodegradable organic polymers throughout the porous calcium polyphosphate samples were formed and resulted in the development of novel composites with attractive strength and toughness. These materials hold promise for formation of biodegradable fracture fixation implants and degradable anchoring systems for temporary stabilization of bone-interfacing implants designed for fixation by bone ingrowth.